Title: Acid Rain

Link to Outcomes:

The students will**:**

- generate a consensus based on data.
- design a scientifically valid experiment to address a question or problem.
- demonstrate a willingness to modify one's ideas based on additional evidence and/or the ideas of others.
- analyze "scientific" findings or claims evaluating the adequacy of the supporting evidence.
- communicate experimental procedures and findings orally and in writing.
- use knowledge of science and available technology to solve a practical problem.

Brief Overview:

This lesson creates an awareness of environmental pollution by focusing on issues of acid rain. Causes and effects of acid rain are discussed, investigations are performed to measure pollutants in local areas, and letters of advocacy are written to promote environmental protection.

Grade/Level:

7th and 8th grade

Duration/Length:

Actual class time is 10 days. Students research and brainstorm for 2 days, perform activities for 7 days, and write letters of advocacy the 10th day.

Prerequisite Knowledge:

The students should be able to describe and explain acid rain, its effects on the environment, and society's concerns and solutions. A basic understanding of Earth Science, Environmental Science, and Basic Chemistry is needed to complete observations and describe cause/effect relationships. Students should know that a concern for the environment has emerged as a dominant theme in the 90's. A major component of this concern examines causes and effects of air pollution.

Pollution originating in one area can affect regions farther away. Air and Ocean Pollution threaten plant and animal life. Global climate driven by solar energy transports pollutants across the globe. A global awareness of the causes of acid rain is necessary to initiate action to decrease and eliminate human causes of acid rain.

Objectives:

The students will be able to:

- describe and explain causes and effects of acid rain.
- distinguish between natural and man-made causes of acid rain.
- brainstorm solutions to causes of acid rain using cooperative groups.
- explain and label water cycle and gas cycle.
- construct a pollution collector.
- explain relationship of sulfur dioxide pollution, dissolved oxygen, and acid level in a local area.
- write advocacy letters promoting environment protection.

Materials/Resources/Printed Materials:

- Current articles on pollution/acid rain
- Investigative materials for each activity
- Worksheets
- Graphic organizers

Development/Procedures:

To begin this unit, students should understand the causes and effects of acid rain. Gather articles which discuss problems and potential solutions from several sources. (National Geographic, NASA "Global Climate", Water Ecology, Air Ecology, magazine articles and texts in education, statistics from industrial and chemical factories.) Students write about natural and man-made-made causes of acid rain. Use cooperative learning groups to identify problems and suggest ways by brainstorming to problem solve. Students apply the understanding by performing and recording observations in a local area. Finally, the students can complete a community service project by writing advocacy letters to legislators lobbying for financial support for environmental projects and clean-ups.

Evaluation:

Students should compare their investigative results. Explanations of possible solutions to reduce acid rain will indicate the level of understanding by the students.

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MAKE A POLLUTION COLLECTOR:

The air is full of particles. Many of those particles are pollutants. Sometimes the rain can wash out many of the pollutants.

Materials: (several for each group)

- funnels
- beakers or jars
- filter papers
- magnifying glass

Steps:

1. Place a funnel with filter paper in each beaker.
2. Leave the collectors in various places on rainy days.
3. Find the wind direction. (News or by clouds)
4. Remove the filter after the rain stops.
5. Open filter and let it dry.
6. Examine the paper with a magnifying glass.

Questions:

l. Are there any particles of pollution?

2. Where do they come from?

3. What does the wind direction have to do with the collection of pollutants?

4. Are there any natural substances present?

INVESTIGATE SULPHUR DIOXIDE POLLUTION IN YOUR AREA

This investigation can show the degree to which your area contains sulphur dioxide pollution.

Materials:

- map of your local area
- magnifying glass
- paper and pencils

Steps:

1. Define lichens and shrubs.
2. Look at the buildings in your area (buildings, walls, roofs, gravestones) to find lichens (the flat orange and green colored ones that grow flat against the surface).
3. Document where you find the lichens.
   NOTE: Lichens will not be found where there is an enormous amount of pollution, but they thrive in the presence of sulfur dioxide.

Questions:

1. If you start in the middle of town and move toward the outskirts of town, do you see a difference in the quantity of lichens present?

2. Draw or find and paste a picture of lichens here.

3. How do lichens help you to determine sulphur dioxide levels?

Measurement of Dissolved Oxygen

Objective: To measure dissolved oxygen (D.O.)

Materials:

- Water samples from different locations:
    a. Pond water
    b. Tap water
    c. Local area water
    d. Distilled water
- Thermometer
- Graduated cylinder, 100 ml.
- Dissolved oxygen kit:
    a. Manganous sulfate solution
    b. Alkaline potassium iodide azide
    c. Sulfamic acid powder
    d. Starch indicator solution
    e. Titration tub, 20 ml
    f. Plastic pipette, with cap
    g. Water sampling bottle, 60 ml
    h. Spoon 1.0 g
- Litmus paper

Steps:

NOTE: Each group tests all four water samples.

A. Treatment of the water sample:

1. Use the graduated cylinder to place 30 *ml* sample water into a glass bottle. Record its temperature and pH level. Be careful not to introduce air into the sample. Cap carefully.

2. Add 4 drops of manganous sulfate solution and 4 drops of alkaline potassium iodide azide. Cap and mix by inverting several times. A precipitate will form. Allow the precipitate to settle below the shoulder of the bottle before proceeding.

3. Use the 1.0 *g* spoon to add one-half level measure of sulfamic acid powder. Cap and gently shake until the reagent and the precipitate have dissolved. A clear-yellow to brown-orange color will develop, depending on the oxygen content of the sample. This is the fixed sample. Perform the following test procedures on all the collected fixed samples:

B. Test procedure:

1. Fill the titration tube to the 20*ml* line with the fixed sample and cap. If the color of the fixed sample is already a very faint yellow, skip to step 3.

2. Fill the direct reading titrator with sodium thiosulfate. Insert the titrator into the center hole of the titration tube cap. While gently shaking the tube, slowly press the plunger to titrate until the yellow-brown color is reduced to a very faint yellow.

3. Remove the titrator and cap. Be careful not to disturb the titrator plunger. Use the pipette to add 8 drops of starch indicator solution. Note: the sample should turn blue.

4. Replace the cap and titrator. Continue titrating until the blue color just disappears. Read the test result where the plunger tip meets the scale. Record as *ppm (parts per million)*.

5. Repeat the above measurements on the water samples collected from different sites. Record a *ppm* D.O. for each sample.

6. Make a chart for the recorded D.O. and different water samples.